

ART. XII.—*On the Age of Auriferous Quartz Veins  
and Alluvial Deposits in Victoria.*

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It has occurred to me that a short paper on the period of time in geological history when the auriferous quartz reefs were formed, which are now found in Upper and Lower Silurian rocks in Victoria, as well as some reference to the age of the gravels derived from them may be of interest. Of late years, by boring and actual mining some of the southern leads have been traced to sites near where the ancient rivers debouched into the ancient seas, and their gravels are overlain with marine strata which upon palæontological evidence may be classed as Miocene or perhaps as Eocene.

The finding recently of an auriferous quartz vein in the South Glenfine Mine proves, as many geologists and miners had expected, that along the continuation of some of the belts of auriferous strata reefs exist far out under the basalt of the plains.

It is known that reefs in these positions exist, and that they are covered by gravels, so that it becomes an important question to decide, whether at the time the earliest tertiary gravels were formed, were there then auriferous quartz reefs in existence in the Silurian strata.

Many people are of the opinion that the deposit of gold in our reefs took place in comparatively recent times, not earlier than the Tertiary period. Murray<sup>1</sup> states that Dr. Selwyn considered that payable gold would not be found in Miocene gravels in Victoria. Murray, however, says that Miocene gravels in Gippsland and in the Yarra basin are payably auriferous.

There is, it may be mentioned, some confusion about the use of the term Miocene, as some authors consider some of the strata called Miocene by Selwyn's Survey are really Eocene. Murray

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<sup>1</sup> *Geology and Physical Geography of Victoria*, p. 152.

follows Selwyn's use of the term, and I adopt their nomenclature in this paper.

It may be both interesting and profitable to collect the opinions of some leading Victorian geologists on the question under review, for we have gravels of all ages, and if only those of middle tertiary age and those younger contain payable gold, then mining must be greatly restricted to what it otherwise would be if gravels formed from recent times right back to Palæozoic times might be in some places profitably worked for their golden contents.

In a paper read before this Society in 1886, "On the Sedimentary, Metamorphic and Igneous Rocks of Ensay" (pp. 56 to 60), Mr. A. W. Howitt states that in his opinion certain of the sedimentary rocks of the Ensay district were probably altered to schists at the close of the Silurian period, and that the formation of the schistose structure was probably due to certain conditions arising from the forces which folded and contorted the strata. Also that the Silurian sediments of Gippsland were much folded before the Middle Devonian limestones of Buchan and Bindi were deposited.

Mr. Howitt says further<sup>1</sup> that probably we can refer the formation of the auriferous veins and lodes generally occurring in the Silurian and Devonian formations to plutonic and volcanic action which prevailed about the close of the Silurian period and was continued in Lower Devonian and on until the geological record closes in the Upper Devonian period.

Murray<sup>2</sup> writes that all fissures now reefs, were not formed in one short period, and that most of them resulted from movements connected with, or closely following the corrugation of the strata. The existence of quartz veins in our Upper Palæozoic conglomerates which contain pebbles of water-worn quartz, proves that the formation of quartz veins was not confined to Silurian rocks, though it attained its supreme development in them. Most of the quartz veins in the Silurian rocks of Victoria were formed prior to the formation of the Upper Palæozoic rocks.

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<sup>1</sup> In Murray, *l.c.*, p. 147.

<sup>2</sup> Murray, *l.c.*, p. 140.

In speaking of the Bendigo rocks Mr. E. J. Dunn<sup>1</sup> says: "There is no evidence that the quartz formed veins in the Silurian rocks before they were bent and folded, but from that time down to the present there is proof that the process has been continually in progress, and quartz veins have formed since the latest known dyke matter was injected." These dykes are supposed to be of tertiary age. The main lines of "saddle-reefs" Mr. Dunn considers to be of vastly greater age.

Mr. E. Lidgey<sup>2</sup> refers the quartz veins of Ballarat to different ages, the cross-courses of the "indicator-belt" being younger than certain main lines which exist on the field, and he states that their formation was probably started when the Lower Silurian rocks of Ballarat were uplifted above the ocean and folded and crumpled.

Mr. H. Herman<sup>3</sup> shows that an auriferous seam occurs in the Upper Devonian rocks of Gladstone Creek, Gippsland, but he does not state at what period the gold was deposited in this seam. From an inspection of his sections, it must have been contemporary with or subsequently to the formation of the Upper Devonian strata.

In Victoria we have cemented and uncemented gravels of many ages from Recent through Tertiary and Mesozoic times to the Upper Silurian period, some of these are auriferous, but geologists differ as to the age of the most ancient gravel which is likely to contain gold, either in payable or unpayable quantity, such gold being of a water-worn character. Murray, in his "Geology of Victoria," writes that much of the stony material and gold of our payable gold drifts was probably disintegrated from matrices and rock masses during Palæozoic and Mesozoic times, and that it is not improbable that some of the lowest beds of the Mesozoic strata between Foster and Turton's Creek may consist of auriferous conglomerates. With this locality I am not familiar. In most places in Victoria where I have noted the beds underlying Mesozoic strata, they are conglomerates formed by glacial or drift-ice action, and the fragments of which they are composed are foreign to the local

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<sup>1</sup> Report on the Bendigo Gold Field, Dept. of Mines Special Reports, p. 26.

<sup>2</sup> Report on the Ballarat East Gold Field.

<sup>3</sup> Trans. Australasian Inst. of Mining Engineers, vol. v., 1898.

bedrock. They appear to be at the base of or older than the Mesozoic strata.

I presume that the conglomerates Mr. Murray mentions were locally formed from the wreck of the Silurian rocks upon which they rest.

The geologists I have quoted all agree that some of our reef fissures in Silurian rocks were filled with auriferous quartz at the time when the Silurian strata were upheaved, folded and crushed, and more or less metamorphosed, and they place that time somewhere between the end of the Silurian period and the final part of the Upper Palæozoic period when a great break in the stratigraphical succession occurs in our Victorian Geology. From my own observations in the field I can agree with the authors whose views I have reviewed, but I go further, and consider it possible that we may have in Victoria an auriferous Upper Silurian conglomerate. To illustrate this opinion I may perhaps be permitted to refer to the geology of the lower part of Wombat Creek, a tributary of the Upper Mitta Mitta River, where there is an unconformable junction between the Lower and the Upper Silurian rocks. The lower series consist of slates and sandstones and quartzites in parts metamorphosed; these rocks are probably of the same age as the schists of the Glen Wills goldfield. Near the Upper Silurian rocks the slates of the older formation are folded sharply into anti- and synclinal folds. From one anticlinal fold, within a chain or two of the conglomerate, I took graptolites, decided by Mr. T. S. Hall, M.A., to be of Lower Silurian age of the Victorian Geological Survey, or as he prefers to call it, Ordovician.<sup>1</sup>

The basal bed of the Upper Silurian rocks is a bouldery conglomerate, some of the stones measuring three feet in diameter. This is succeeded by finer conglomerates, sandstones, shales and limestones; the shales and limestones are in places crowded with corals, shells, and trilobites, determined by Mr. R. Etheridge, jr., to be of Upper Silurian age.<sup>2</sup> Lithologically and stratigraphically the upper and lower series of rocks present a striking unconformability to each other. The upper rocks are not

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<sup>1</sup> Proc. Roy. Soc. Victoria, N.S., vol. ix.

<sup>2</sup> Progress Report, No. 10, Geo. Survey, Victoria, pp. 100 and 101.

contorted anywhere where I examined them ; the lower rocks are much contorted ; quartz veins occur in the folded rocks, and must have been deposited previous to the formation of the Upper Silurian rocks. I may here word my position in this manner, auriferous saddle reefs, and various forms of quartz deposits occur associated with the folding of the Lower Silurian strata at Bendigo and elsewhere. Payable gold has been found in the recent gravels of the upper portions of Wombat Creek, where the rocks are of Lower Silurian age, but lower down the creek where the rocks are Upper Silurian no payable gold has been obtained. Folded strata exist at Wombat Creek in the Lower Silurian rocks, but not in those of the Upper Silurian which overlie them. If any quartz veins exist which are connected with the folding of the Lower Silurian rocks at Wombat Creek, gold from portions of such reefs, etc., may now exist as "alluvial" gold in the Upper Silurian conglomerate, which consists, in part, of the detritus of the denuded Lower Silurian rocks. The Lower Silurian rocks were contorted and denuded before the Upper Silurian rocks were deposited upon them. It does not seem probable that any fissures would long remain open, for if not filled by some precipitated mineral or by a dyke, they would soon be filled by particles of the country rocks scaling off the walls, and a breccia would be formed. I consider it improbable that fissures formed in the Lower Silurian period would remain open and be filled by quartz in any subsequent period. Generally speaking, schistose rocks are very rare in our Upper Silurian strata, but are abundant in those of the Lower Silurian. At the junction of micaceous and other schists with granite at various places, notably Corryong, there are auriferous contact quartz veins. I consider that these granitic intrusions took place, and the associated quartz veins were formed prior to the formation of the Upper Silurian strata. At Wombat Creek the Lower Silurian rocks are metamorphosed, while the Upper are not. The schistose rocks of Corryong greatly resemble those of Wombat Creek and between these places there is a general similarity in the intervening metamorphic rocks, which appear to be Lower Silurian strata more or less altered. Within this metamorphic area the unaltered Upper Silurian rocks occur, and I consider that the formation of the auriferous reefs at Corryong was contempo-

aneous with the metamorphism of the strata. At the Golden Mountain Mine, at Bonnie Doon, gold has been mined at the contact of granite with Upper Silurian rocks which are altered by contact metamorphism but a short distance from the junction. I consider that the granite intrusions of Doon took place at a later period than the granitic intrusions of Corryong and Glen Wills ; because here Upper Silurian rocks are altered while at Wombat Creek they are not. From the consideration of dykes we may obtain a certain amount of evidence bearing on the age of some quartz veins. In the Upper Silurian Strata the greater number of auriferous quartz veins are associated with dykes, notably diorite ; they occur in, and across, and adjacent to the dykes, and are subsequent to them. In the Lower Silurian rocks the reefs are not as a rule connected with dykes, but in some places ancient granitic dykes fault reefs, which are the older. At Wombat Creek granitic dykes occur in the Lower Silurian rocks but were not noted in the Upper series ; and if sections were available dykes might perhaps be seen to intersect the Lower rocks but to stop at, and not enter the Upper series, just as in the Werribee Gorge a quartz-porphyry dyke is stated in a note on the quarter sheet of the Geological survey of that locality to intersect the Lower Silurian rocks but not to penetrate the overlying beds of glacial conglomerate.

In a mining item published recently by one of the Melbourne dailies, the statement is made that alluvial gold will not be found far south of the northern fringe of the Pitfield Plains as the marine strata commence there and the alluvial will not extend into them though the reefs may continue further south. I consider that along some of the belts of auriferous country, especially when the gold in the reefs has been of a nuggety character it may pay in places to follow the line of reefs under the marine wash and work for alluvial where the gold has been concentrated by local conditions.<sup>1</sup> To summarize briefly then : I consider that we have no fear of any Tertiary gravels being poor in gold for the reason that auriferous quartz veins were not in existence when they were deposited but that possibly the later formed gravel beds will be richer in gold than the earlier,

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<sup>1</sup> Murray, *l.c.*, p. 153.

for the reason that the stones and the gold may have formed portion of the mass of some gravel, which was denuded before the formation of the more recent gravel, as suggested by Murray.<sup>1</sup> Also, it is my opinion that we may have auriferous locally formed gravels of any age from Upper Silurian to recent times, and I know of no geological reason why a nugget may not have once existed in a quartz reef in Lower Silurian rocks have been denuded out and have rested for a while in an Upper Silurian gravel, have been washed out again and become locked up in a gravel of Devonian age and have passed in turn through a Mesozoic, and Tertiary and finally when in a much reduced size be taken from a wash of Post Pliocene age; and that there may exist in Victoria in certain favoured spots auriferous gravels of any age from Upper Silurian to recent.

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<sup>1</sup> Murray, *l.c.*, p. 155.

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